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Studies on extension of shelf life of poultry carcass in processing line

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Abstract

A study was conducted on extending the shelf life of poultry carcass. Generally poultry meat is a perishable product and has high nutritional value. Poultry meat consumption is constantly increasing worldwide and therefore ensuring the microbial safety of carcass is essential. As meat is susceptible to microbial growth, special care and attention must be paid to ensure good shelf life. This study has been undertaken to implement two changes in the poultry processing line for increasing shelf life of the poultry carcass. The changes made are increasing the retention time of detergent and sanitizer in processing line during CIP process from 10 minutes to 20 minutes in order to improve the cleaning efficiency and second change is reduction of screw chiller water temperature from 10°C to 2°C in several trials. After implementation of these two parameters, shelf life study was evaluated by considering the sensory and microbiological results for poultry carcass which was increased from 4 days to 6 days.

Keywords: Poultry meat, spoilage, shelf life, CIP, screw chiller

1. Introduction

Poultry meat is a commonly consumed food product in many countries because of its relatively low cost of production, low fat content, high nutritional value and distinct odour and also having different types of processed poultry products. According to Lambert *et al.*, (1991) [3] the most significant spoilage of meat is done by microbial growth and influences the sensory properties of meat including appearance, texture, color and odour. Additionally, bacterial growth reduces the product safety, which is of great concern to consumers of meat products Prendergast (1997) [5]. According to Pooni & Mead (1984) [4] product shelf life is determined by number of spoilage organisms present initially and maintaining the temperature of the product at all stages of production, storage and handling. After slaughter a poultry carcass has to be chilled to reduce and then maintain the temperature of the meat below a value that will ensure a high quality, safe product. The main purpose of chilling is to reduce carcass temperature below the minimum growth temperature of most food borne pathogens and spoilage microorganisms. The United States Department of Agriculture (USDA) requires that poultry carcasses be chilled to 4 °C or lower. The immersion chill system is the most commonly utilized chill system for chilling of the poultry carcass (Carroll and Alvarado, 2008; Sams and McKee, 2010) [2, 7]. Immersion chill systems are set up to immerse the broilers in chilled water to lower the temperatures of the carcasses to less than 4 °C. Hygiene is also one of the important activities in the meat plant related to public health issue. From the slaughtering of birds to storage at the distributor, there are a number of points where special care and attention must be paid to ensure good shelf life. In that cleaning and sanitation is one of the major important factor can affect the shelf life of the product and it is also an integral part of GMP and GHP.

2. Materials and Methods

Broiler birds were procured from local market of Mahabubnagar and slaughtered in Sneha Chicken processing plant, Addakal, Mahabubnagar, adopting traditional halal method.

Following are the trials taken for the study

1. To improve cleaning efficiency by increasing the retention time of Detergent and Sanitizer
2. To decrease the screw chiller water temperature from 10 °C to 2 °C

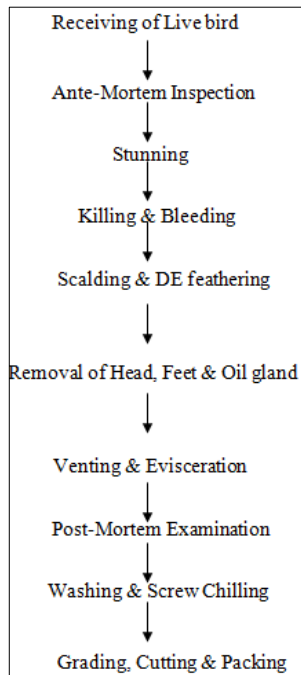


Fig 1: General description of Slaughtering & Dressing of Poultry in processing line

2.1 To improve cleaning efficiency by increasing retention time of Detergent and Sanitizer

2.1.1 Chemicals

SU-120 and SU-727 are the chemicals used as detergent and sanitizer during CIP process.

SU-120 is a concentrated, neutral, high-foaming liquid detergent designed for general-purpose application in the food, beverage and dairy Industries. SU-727 is used for foam generating chemical for cleaning in food industry. These both are chlorinated foam cleaners designed for daily use in the food, beverage and dairy industries.

2.1.2 CIP Procedure

Remove all loosely attached meat pieces and other material from the equipments with the help of water jet. Apply SU-120 @ 2.0% and scrub with the brush for about 10mins to remove all extraneous matter. And then apply SU-727 @2.0% for about 10mins. Wash the dirt off with pressurized water jet. Disinfect by spraying 100ppm of chlorine. Once cleaning is completed swabs are collected from drains and equipments to analyse for Microbiological count of TPC, coliform and *Staphylococcus aureus*. So trials are conducted by increasing the retention time for detergent and sanitizers at 15min and 20 min. Microbial growth was observed by collecting the samples at each retention time.

2.2 To decrease the screw chiller water temperature from 10 °C to 2 °C

Chilled temperature should be maintained in screw chiller having a concentration of 8-12% chlorine solution which is continuously dosed with the help of an automatic dozer. Overall concentration in the screw chiller should not exit 50 ppm. In addition to this citric acid solution is to be used to maintain the water pH between 5.5 to 6.5. Care should be taken that the chilling temperature of the carcass in screw chiller. Trials are conducted by reducing the water temperature from 10°C to 8 °C and then 6 °C and same procedure is repeated for 4 °C and 2 °C. Microbial growth is observed by collecting the samples at each temperature

respectively.

2.3 Shelf life study

After implementation of these two parameters shelf life study was conducted for poultry carcass. Overall shelf life study was carried out for 7 days, 30 samples of each product were collected and stored at below 4°C. The date of slaughter is considered as 0thday. On each test day, 3 samples of each product were assessed in triplicates for sensory and microbial evaluation.

2.4 Sensory Evaluation

An effective method for sensory evaluation of raw carcass were analysed by 5 trained panellists and 5 semi trained panellists. Each panellist was asked to rate the liking quality attribute according to colour, odour, texture and overall acceptability of each sample using 9-point Hedonic scale (1= dislike extremely, 2= dislike very much, 3= dislike moderately, 4= dislike slightly, 5= neither dislike nor like, 6= like slightly, 7= like moderately, 8= like very much and 9= like extremely).

2.5 Microbiological analysis

2.5.1 Total plate count

23.5g plate count agar obtained from Hi-Media Laboratories Pvt Ltd., Mumbai (Code No.M091) was suspended in 1000 ml distilled water and boiled to dissolve the media completely and sterilized by autoclaving at 15 lb pressure at 121 °C for 15 min. Final pH of the media was adjusted to 7.0±0.2. Duplicate sets of petri dishes were inoculated aseptically with 1 ml aliquots from appropriate dilutions. About 20ml of plate count agar, melted and maintained at 44-46 °C, was poured gently. The plates were incubated at 37±1 °C for 48 h. Plates showing 30-300 colonies were counted. The number of colonies were multiplied with reciprocal of the dilution and expressed as log₁₀ cfu/g.

2.5.2 Coliform count

A quantity of 41.5 g of violet red bile agar (hi-Media laboratories Pvt. Ltd., Mumbai (Code M 049) was suspended in 1000 ml of distilled water. It was then boiled to dissolve the medium completely and cooled to 45 °C. The final pH of the medium was 7.4±0.2 at 25 °C. Pour plate with overlay technique was followed for inoculation of suitable sample dilutions and the plates were incubated at 35±2 °C for 24 hours. The colonies that appeared on the plates were counted and expressed as log₁₀ cfu/g.

2.5.3 Salmonella Count

A quantity of 72.66 gm of Hektoen Enteric agar (hi-Media laboratories Pvt. Ltd., Mumbai (Code M 049) was suspended in 1000 ml of distilled water and boiled to dissolve the medium completely and cooled to 45 °C. The final pH of the medium was adjusted to 7.30-7.70 and it was not autoclaved. Pour plate with overlay technique was followed for inoculation of suitable sample dilutions and the plates were incubated at 30-35 °C for 24-48 hours. The colonies that appeared on the plates were counted and expressed as log₁₀ cfu/g.

2.5.4 Staphylococcus aureus

Collect the samples and prepare for serial dilutions. Add 1ml of inoculum to petri plate containing Braid Packer agar for determination of *Staphylococcus aureus*. These plates are

incubated at 37 °C for 24h. All the plates were examined visually for colony count and report the results in terms of colony forming unit per gram of sample (cfu/g).

2.6 Statistical analysis

The experiment was repeated a minimum of three times in duplicate and the data generated for different meat quality parameters were compiled and analyzed using SPSS (version 20.0 for Windows; SPSS, Chicago, 111, U.S.A.). The data were subjected to analysis of variance, (oneway ANOVA for different temperature abuse), least significant difference and Duncan's multiple range test for comparing the means to find the difference between groups and different temperature abuse. The smallest difference ($D_5\%$) for two means was reported as significantly different ($p<0.05$).

3. Results and Discussion

3.1 Improved cleaning efficiency by increasing retention time of Detergent and Sanitizer

A significant ($p<0.05$) reduction of TPC count was observed after increasing the retention time of detergent & Sanitizer from 10min to 20min. Using SU-120 @ 2.0% & SU-727 @ 2.0% rested for 20min is more effective when compared with retention time of 10min and 15min. At 10 min and 15min retention time, the TPC count is significantly ($p<0.05$) high compared to 20 min retention time, so there is a chance to increase in microbial growth which can further causes spoilage of the product at 10 min and 15min retention time but at 20min retention time microbial count is significantly ($p<0.05$) low. So the retention time of 20min is standardized for cleaning procedure in processing line.

Table 1: Microbiological count at various retention times

Retention Time	Day	Total Plate Count (log cfu/gm)	Total coliform count (log cfu/gm)	Staphylococcus aureus (log cfu/gm)
10min	Day 1	4.02±0.28 ^d	Absent	Absent
	Day 2	3.85±0.16 ^d	Absent	Absent
	Day 3	4.92±0.06 ^b	Absent	Absent
	Day 4	5.04±0.10 ^b	Absent	Absent
	Day 5	5.18±0.02 ^a	Absent	Absent
	Day 6	5.28±0.05 ^a	Absent	Absent
15 min	Day 1	3.98±0.18 ^d	Absent	Absent
	Day 2	4.06±0.16 ^d	Absent	Absent
	Day 3	4.34±0.06 ^c	Absent	Absent
	Day 4	4.42±0.08 ^c	Absent	Absent
	Day 5	4.48±0.14 ^c	Absent	Absent
	Day 6	5.06±0.04 ^b	Absent	Absent
20 min	Day 1	2.85±0.11 ^e	Absent	Absent
	Day 2	2.96±0.14 ^e	Absent	Absent
	Day 3	3.02±0.04 ^e	Absent	Absent
	Day 4	3.12±0.06 ^f	Absent	Absent
	Day 5	3.28±0.12 ^f	Absent	Absent
	Day 6	3.65±0.10 ^g	Absent	Absent

Means with different superscripts in the same row indicate significance difference ($p<0.05$)

3.2 Decrease in screw chiller water temperature

Screw chiller water temperature maintained at 10 °C, the Total Plate Count (TPC) is significantly ($p<0.05$) high. So trials were conducted by reducing the water temperature from 10 °C to 8 °C. But there is no significant ($p<0.05$) difference in microbial growth maintained at 8 °C. It is further reduced to 6 °C, but at this point the microbial count (TPC) is near to the limit so there is a chance for cross contamination and spoilage of meat. Finally the microbial results were satisfactory when water temperature is maintained at 4 °C and 2 °C. But at 2 °C chilling cost was increased but microbial count is significantly ($p<0.05$) low compared to 4 °C. So water temperature at 4 °C in screw chiller is a cost effective process to reduce the

microbial growth of the product. The absence of coliforms, Staph. aureus and salmonella may be attributed to the hygienic handling and sanitary conditions adopted at slaughter process. Similarly Thiessen *et al.* (1984) [6] reported that chilled water in a poultry processing plant treated with chlorine dioxide (ClO_2) at various concentrations from 0 to 1.39 mg/liter resulted in reduction of the bacterial count to the point, where *salmonellae* could not be isolated from the chill water or the chilled broiler carcasses. Berrang *et al.* (2000) [1] also observed mesophilic bacterial count /ml of log 4.6 on the day 0 and increased by 2 logs after 4 days on poultry carcass held at 4 °C.

Table 2: Microbiological count of poultry carcass at various temperatures of screw chiller water

Chiller water temp.	Day	TPC (log cfu/gm)	Coliform (log cfu/gm)	Staph. Aureus (log cfu/gm)	Salmonella (Absent/25g)
10 °C	Day 1	5.58±0.12 ^d	Absent	Absent	Absent
	Day 2	5.66±0.06 ^d	Absent	Absent	Absent
	Day 3	5.98±0.04 ^c	Absent	Absent	Absent
	Day 4	6.32±0.14 ^b	Absent	Absent	Absent
	Day 5	6.44±0.12 ^b	Absent	Absent	Absent
	Day 6	6.82±0.04 ^a	Absent	Absent	Absent
8 °C	Day 1	5.08±0.12 ^e	Absent	Absent	Absent
	Day 2	5.12±0.08 ^e	Absent	Absent	Absent
	Day 3	5.14±0.06 ^e	Absent	Absent	Absent

	Day 4	5.22±0.10 ^e	Absent	Absent	Absent
	Day 5	5.44±0.04 ^d	Absent	Absent	Absent
	Day 6	6.14±0.02 ^b	Absent	Absent	Absent
6 °C	Day 1	4.98±0.08 ^e	Absent	Absent	Absent
	Day 2	5.06±0.04 ^e	Absent	Absent	Absent
	Day 3	5.10±0.06 ^e	Absent	Absent	Absent
	Day 4	5.38±0.10 ^d	Absent	Absent	Absent
	Day 5	5.56±0.06 ^d	Absent	Absent	Absent
	Day 6	5.89±0.04 ^c	Absent	Absent	Absent
4 °C	Day 1	3.20±0.08 ^h	Absent	Absent	Absent
	Day 2	3.34±0.04 ^g	Absent	Absent	Absent
	Day 3	3.36±0.06 ^g	Absent	Absent	Absent
	Day 4	3.58±0.08 ^g	Absent	Absent	Absent
	Day 5	3.72±0.02 ^f	Absent	Absent	Absent
	Day 6	3.88±0.08 ^f	Absent	Absent	Absent
2 °C	Day 1	2.34±0.14 ⁱ	Absent	Absent	Absent
	Day 2	2.38±0.06 ⁱ	Absent	Absent	Absent
	Day 3	2.48±0.08 ⁱ	Absent	Absent	Absent
	Day 4	2.88±0.10 ^h	Absent	Absent	Absent
	Day 5	3.20±0.04 ^h	Absent	Absent	Absent
	Day 6	3.44±0.05 ^g	Absent	Absent	Absent

Means with different superscripts in the same row indicate significance difference ($p < 0.05$)

3.3 Sensory evaluation

Sensory analysis was conducted by considering colour, odour, texture and overall acceptability of poultry carcass. Organoleptic sensory scores of colour, odour, texture and overall acceptability was gained good scores up to 6 days. On 7th day slight yellowish colour and slimy in texture of the product was observed, Whereas on 8th day dark yellowish colour, foul smell of the product with slimy texture was observed and overall acceptability was gained score of 2.0 which is unacceptable by the panellists. So carcass was acceptable up to 6 days on the basis of sensory evaluation results.

Table 3: Sensory score of poultry carcass under refrigerated storage (Nine-Point Hedonic Scale)

S. No	Day	Colour	Odour	Texture	Overall acceptability
1.	Day 0	9.0	9.0	9.0	9.0
2.	Day 1	8.8	8.9	8.8	8.8
3.	Day 2	8.5	8.5	8.5	8.5
4.	Day 3	8.0	8.0	8.0	8.0
5.	Day 4	7.6	7.5	7.5	7.3
6.	Day 5	7.2	7.4	7.0	7.0
7.	Day 6	6.5	6.5	6.5	6.5
8	Day 7	4.0	4.0	3.5	3.5
9	Day 8	2.0	2.0	2.0	2.0

(1= dislike extremely, 2= dislike very much, 3= dislike moderately, 4= dislike slightly, 5= neither like nor dislike, 6= like slightly, 7= like moderately, 8= like very much and 9= like extremely)

4. Conclusion

A study was conducted on extending the shelf life of poultry carcass. Present research was carried out with objectives to improve cleaning efficiency by increasing retention time of detergent and sanitizer during CIP process, to decrease the screw chiller water temperature in order to maintain the temperature of the carcass. Based on the Microbiological and sensory analysis of the result, it was concluded that, during CIP process, using detergent and sanitizer for 20min retention time is more effective when compared with 10min and 15min. Therefore at 20min retention time is standardized for CIP. Screw chiller water temperature is maintained at 10 °C, 8 °C & 6 °C, the microbial count is significantly ($p < 0.05$) high. So the

water temperature was reduced to 4 °C & 2 °C. Finally the microbial results were satisfactory when water temperature was maintained at 4 °C & 2 °C. But at 2 °C chilling cost is increased when compared to 4 °C. So maintaining water temperature at 4 °C in screw chiller is a cost effective process to reduce the microbial growth of the product. Hence, these changes were implemented during processing of poultry carcass which further increased the shelf life from 4 days to 6 days for poultry carcass without any undesirable changes in quality.

5. References

- Berrang ME, Northcutt JK, Smith DP, Lyon CE. Incidence of *Listeria monocytogenes* on pre-scald and post-chill chicken. *J Appl. Poult. Res.* 2000;9:546-550.
- Carroll CD, Alvarado CZ. Comparison of air and immersion chilling on meat quality and shelf life of marinated broiler breast filets. *Poultry Science.* 2008;87:368-372.
- Lambert AD, Smith JP, Dodds Karen L. Shelf life extension and microbiological safety of fresh meat: A review. *Food Microbiology.* 1991;8:267-297.
- Pooni GS, Mead GC. Prospective use of temperature function integration for predicting the shelf life of non-frozen poultry meat products. *Food microbiology.* 1984;1:67-78.
- Prendergast H, Moazzami AA, Fazly Bazzaz BS. Inhibition of mutagenic N-nitroso compound formation in sausage samples using L-ascorbic acid and atocopherol. *Meat Science.* 2002;62:479-483.
- Thiessen GP, Osborne WR, Orr HL. The efficacy of chlorine dioxide in controlling *Salmonella* contamination and its effect on product quality of chicken broiler carcasses. *Poultry science.* 1984;63(4):647-653.
- Sams AR, McKee SR. First processing: Slaughter through chilling in Poultry Meat Processing, 2010, 25-50.
- USDA-FSIS. Poultry products inspection regulations. Title 9. Code of Federal Regulations, 2014c, 381.91.